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Julia T. Choi

University of Massachusetts Amherst

Et al.

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Visually Guided Inter-limb Adaptation During Walking In Children And Adults

Julia T Choi^{1,2}, Peter Jensen², and Jens Bo Nielsen²

¹University of Massachusetts, Amherst, MA USA; ²University of Copenhagen, Denmark
Email: jtchoi@kin.umass.edu

Voluntary visually guided movements must be constantly adapted to maintain accuracy. Here we applied principles of visuomotor adaptation to drive inter-limb adaptation of joint kinematics during voluntary, visually guided walking. We tested whether step length symmetry could be adapted and stored after training with mismatched visual feedback on two legs.

17 healthy children (9M/8F, 6-15 yrs) and 8 healthy adults (7M/1F, 26±6 yrs) were tested. We created a computer task where subjects modified step length trial-by-trial to hit virtual targets while walking on a treadmill. The relationship between screen-space and treadmill-space was defined by a visuomotor gain for each leg. Each test consisted of a baseline period (same gain on both legs), an adaptation period (one high gain, one low gain) and a post-adaptation period (same gain). The 'fast leg' and 'slow leg' refers to the leg adapted with the higher and lower gain, respectively. During the adaptation period, the leg adapted with the higher gain appeared to move fast, and the other leg appeared to move slowly on display.

All healthy children and adults tested could rescale step length to maintain endpoint accuracy during visually guided walking. Step length gradually became more asymmetric during adaptation. The fast leg shortened step length (to correct overshoot), and the slow leg lengthened step length (to correct undershoot). In the post-adaptation period, step length asymmetry persisted (after-effect) despite the fact that the gains have returned to normal. The presence of an after-effect indicates storage of a new inter-limb visuomotor calibration. The after-effect was partially washed out after one minute of post-adaptation walking.

This study suggests that visually guided inter-limb adaptation can alter step length, a major determinant of gait stability and energetic costs. This may open up new opportunities to correct abnormal, asymmetric walking patterns in children and adults with neurological damage.